

## WEST Search History

DATE: Tuesday, July 26, 2005

Hide?	<u>Set</u> <u>Name</u>	<u>Query</u>	<u>Hit</u> <u>Count</u>
		<i>DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=ADJ</i>	
<input type="checkbox"/>	L54	6741152	2
<input type="checkbox"/>	L53	L52 and ((magnetic adj resonance) or MRI or NMR)	24
<input type="checkbox"/>	L52	L51 and ((hollow or tube or cylindrical or cylinder or tubular or capillary or capillary) with (strip or tape or ribbon or conduct\$4 or electric\$4 or conduit or rod or bar or winding))	24
<input type="checkbox"/>	L51	L50 and ((fluid\$3 or water or coolant or liquid or cool\$4 or (ethylene adj glycol)) with (inside or internal or inner or "within" or (between with wind\$3)) with (gradient adj coil))	29
<input type="checkbox"/>	L50	L49 and ((fluid\$3 or water or coolant or liquid or cool\$4 or (ethylene adj glycol)) with (inside or internal or inner or "within" or (between with wind\$3)) with (gradient or coil))	169
<input type="checkbox"/>	L49	L48 and ((flow\$4 or moving or move or movement or motion or movable or moved or pass or passing or passed or conduct\$3 or direct\$3 or divert\$3) with (fluid\$3 or water or coolant or liquid))	364
<input type="checkbox"/>	L48	l2 and ((hollow or tube or cylindrical or cylinder or tubular) with (gradient with coil))	1508
<input type="checkbox"/>	L47	l2and ((hollow or tube or cylindrical or cylinder or tubular) with (gradient with coil))	0
<input type="checkbox"/>	L46	5786695	15
<input type="checkbox"/>	L45	6111412	12
<input type="checkbox"/>	L44	19722211	2
<input type="checkbox"/>	L43	19721985	3
<input type="checkbox"/>	L42	6741152	2
<input type="checkbox"/>	L41	19839987	2
<input type="checkbox"/>	L40	L39 and (flat\$4 or planar or pancake or open or thermal\$2 or heat\$4 or temperature)	11
<input type="checkbox"/>	L39	L38 and ((fluid\$3 or water or coolant or liquid or cool\$4 or (ethylene adj glycol)) with (gradient))	18
<input type="checkbox"/>	L38	(heid.in.)	618
<input type="checkbox"/>	L37	L36 and (pipe or plumbing or piping or piped)	5
<input type="checkbox"/>	L36	L35 and ((fluid\$3 or water or coolant or liquid or cool\$4 or (ethylene adj glycol)) with (gradient))	18
<input type="checkbox"/>	L35	L34 and (wound or winding or coiled or coiling or looping or loop or coil or helix or helical\$3 or looped or spiral\$4)	49
		L33 and (flat\$4 or planar or pancake or open or thermal\$2 or heat\$4 or	

<input type="checkbox"/>	L34	temperature)	49
<input type="checkbox"/>	L33	L32 and (switch\$4)	49
<input type="checkbox"/>	L32	L31 and (water or (ethylene adj glycol))	82
<input type="checkbox"/>	L31	L30 and (shield\$4)	131
<input type="checkbox"/>	L30	L29 and ((magnetic adj resonance) or MRI or NMR)	195
<input type="checkbox"/>	L29	L28 and ((transvers\$4 or "x" or "y" or horizontal\$2 or vertical\$2) with (gradient or coil))	418
<input type="checkbox"/>	L28	L27 and ((hollow or tube or cylindrical or cylinder or tubular or capillary or capillary) with (strip or tape or ribbon or conduct\$4 or electric\$4 or conduit or rod or bar or winding))	815
<input type="checkbox"/>	L27	L26 and ((flow\$4 or moving or move or movement or motion or movable or moved or pass or passing or passed or conduct\$3 or direct\$3 or divert\$3)with (fluid\$3 or water or coolant or liquid))	1560
<input type="checkbox"/>	L26	L25 and (flow\$4 or moving or move or movement or motion or movable or moved or pass or passing or passed or conduct\$3 or direct\$3 or divert\$3)	2656
<input type="checkbox"/>	L25	L24 and (wound or winding or coiled or coiling or looping or loop or coil or helix or helical\$3 or looped)	2670
<input type="checkbox"/>	L24	L23 and (strip or tape or ribbon or conduct\$4 or electric\$4 or conduit or rod or bar or winding)	2670
<input type="checkbox"/>	L23	L2 and (fluid\$3 or water or coolant or liquid)	2885
<input type="checkbox"/>	L22	L17 and (water or (ethylene adj glycol))	23
<input type="checkbox"/>	L21	L20 and (switch\$4)	9
<input type="checkbox"/>	L20	L19 and (shield\$4)	10
<input type="checkbox"/>	L19	L18 not L13	16
<input type="checkbox"/>	L18	L17 and (flat\$4 or planar or pancake or open or thermal\$2 or heat\$4 or temperature)	31
<input type="checkbox"/>	L17	L11 and ((magnetic adj resonance) or MRI or NMR)	35
<input type="checkbox"/>	L16	L15 and ((magnetic adj resonance) or MRI or NMR)	2
<input type="checkbox"/>	L15	L14 and (switch\$4)	7
<input type="checkbox"/>	L14	L13 and (shield\$4)	19
<input type="checkbox"/>	L13	L12 and (flat\$4 or planar or pancake or open or thermal\$2 or heat\$4 or temperature)	28
<input type="checkbox"/>	L12	L10 and (transvers\$4 with (gradient or coil))	31
<input type="checkbox"/>	L11	L9 and (transvers\$4 with (gradient or coil))	66
<input type="checkbox"/>	L10	L9 and (helix or helical\$2 or spiral\$2)	52
<input type="checkbox"/>	L9	L8 and ((hollow or tube or cylindrical or cylinder or tubular) with (strip or tape or ribbon or conduct\$4 or electric\$4 or section))	129
<input type="checkbox"/>	L8	L7 and ((flow\$4 or moving or move or movement or motion or movable or moved or pass or passing or passed) with (fluid\$3 or water or coolant or liquid))	217
<input type="checkbox"/>	L7	L6 and (flow\$4 or moving or move or movement or motion or movable or moved or pass or passing or passed)	465

<input type="checkbox"/>	L6	L5 and (wound or winding or coiled or looped)	483
<input type="checkbox"/>	L5	L4 and (strip or tape or ribbon or conduct\$4 or electric\$4)	974
<input type="checkbox"/>	L4	L3 and (fluid\$3 or water or coolant or liquid)	1065
<input type="checkbox"/>	L3	L2 and (transvers\$4)	1702
<input type="checkbox"/>	L2	L1 and (hollow or tube or cylindrical or cylinder or tubular)	5047
<input type="checkbox"/>	L1	(gradient with coil)	10717

END OF SEARCH HISTORY

## Hit List

[Clear](#) [Generate Collection](#) [Print](#) [Fwd Refs](#) [Bkwd Refs](#)  
[Generate OACS](#)

Search Results - Record(s) 1 through 24 of 24 returned.

☐ 1. Document ID: US 20050146330 A1

L53: Entry 1 of 24

File: PGPB

Jul 7, 2005

PGPUB-DOCUMENT-NUMBER: 20050146330  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20050146330 A1

TITLE: Cylindrical bi-planar gradient coil for MRI

PUBLICATION-DATE: July 7, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Teklemariam, Grum	North Andover	MA	US	
Lian, Jianyu	Westford	MA	US	

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw D
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☐ 2. Document ID: US 20050093543 A1

L53: Entry 2 of 24

File: PGPB

May 5, 2005

PGPUB-DOCUMENT-NUMBER: 20050093543  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20050093543 A1

TITLE: Thermal management apparatus and uses thereof

PUBLICATION-DATE: May 5, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Arik, Mehmet	Niskayuna	NY	US	
Rohling, Kenneth William	Niskayuna	NY	US	
Watkins, Ronald Dean	Niskayuna	NY	US	

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw D
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☐ 3. Document ID: US 20050035764 A1

L53: Entry 3 of 24

File: PGPB

Feb 17, 2005

PGPUB-DOCUMENT-NUMBER: 20050035764  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20050035764 A1

TITLE: METHOD AND APPARATUS FOR DIRECTLY COOLING HOLLOW CONDUCTOR WOUND TRANSVERSE  
GRADIENT COIL BOARDS

PUBLICATION-DATE: February 17, 2005

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Mantone, Anthony	Florence	SC	US	
Clarke, Neil	Florence	SC	US	
Duby, Tomas	Florence	SC	US	
Liu, Qin	Waukesha	WI	US	
Sellers, Michael B.	Florence	SC	US	

US-CL-CURRENT: 324/318; 324/309, 324/315

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw D
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☐ 4. Document ID: US 20050030028 A1

L53: Entry 4 of 24

File: PGPB

Feb 10, 2005

PGPUB-DOCUMENT-NUMBER: 20050030028  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20050030028 A1

TITLE: APPARATUS FOR ACTIVE COOLING OF AN MRI PATIENT BORE IN CYLINDRICAL MRI  
SYSTEMS

PUBLICATION-DATE: February 10, 2005

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Clarke, Neil	Florence	SC	US	
Sellers, Michael B.	Florence	SC	US	
Allford, Michael L.	Florence	SC	US	
Mantone, Anthony	Florence	SC	US	

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw D
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☐ 5. Document ID: US 20030141870 A1

L53: Entry 5 of 24

File: PGPB

Jul 31, 2003

PGPUB-DOCUMENT-NUMBER: 20030141870  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20030141870 A1

TITLE: Magnetic resonance apparatus with an electrical conductor arrangement for electrical supply to a conduit

PUBLICATION-DATE: July 31, 2003

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Schuster, Johann	Oberasbach		DE	
Stocker, Stefan	Erlangen		DE	

US-CL-CURRENT: 324/318; 324/320, 324/321, 324/322

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	Kind	Draw D.
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☐ 6. Document ID: US 20020156595 A1

L53: Entry 6 of 24

File: PGPB

Oct 24, 2002

PGPUB-DOCUMENT-NUMBER: 20020156595  
PGPUB-FILING-TYPE: new  
DOCUMENT-IDENTIFIER: US 20020156595 A1

TITLE: Predictive thermal control used with a vacuum enclosed coil assembly of a magnetic resonance imaging device

PUBLICATION-DATE: October 24, 2002

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Hedlund, Carl R.	Waterford	NY	US	
Emeric, Pierre R.	Milwaukee	WI	US	

US-CL-CURRENT: 702/132

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	Kind	Draw D.
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☐ 7. Document ID: US 20020148604 A1

L53: Entry 7 of 24

File: PGPB

Oct 17, 2002

PGPUB-DOCUMENT-NUMBER: 20020148604  
PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20020148604 A1

TITLE: Method and system to regulate cooling of a medical imaging device

PUBLICATION-DATE: October 17, 2002

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Emeric, Pierre R.	Milwaukee	WI	US	
Hedlund, Carl R.	Waterford	NY	US	

US-CL-CURRENT: 165/206

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw D
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☐ 8. Document ID: US 20020073717 A1

L53: Entry 8 of 24

File: PGPB

Jun 20, 2002

PGPUB-DOCUMENT-NUMBER: 20020073717

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20020073717 A1

TITLE: MR scanner including liquid cooled RF coil and method

PUBLICATION-DATE: June 20, 2002

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Dean, David E.	Hartland	WI	US	
Assif, Benny	Ramat Hasharon		IL	
Hugg, James W.	Kiryat Hayim		IL	

US-CL-CURRENT: 62/50.7; 62/259.2, 62/51.1

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KMC	Draw D
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☐ 9. Document ID: US 20010033168 A1

L53: Entry 9 of 24

File: PGPB

Oct 25, 2001

PGPUB-DOCUMENT-NUMBER: 20010033168

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20010033168 A1

TITLE: Electrical coil

PUBLICATION-DATE: October 25, 2001

## INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Heid, Oliver	Gunzenhausen		DE	

US-CL-CURRENT: 324/322; 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	FIG	Draw D
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☐ 10. Document ID: US 6909283 B2

L53: Entry 10 of 24

File: USPT

Jun 21, 2005

US-PAT-NO: 6909283

DOCUMENT-IDENTIFIER: US 6909283 B2

TITLE: Method and system to regulate cooling of a medical imaging device

DATE-ISSUED: June 21, 2005

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Emeric, Pierre R.	Milwaukee	WI		
Hedlund, Carl R.	Waterford	NY		

US-CL-CURRENT: 324/300; 324/306

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	FIG	Draw D
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☐ 11. Document ID: US 6812705 B1

L53: Entry 11 of 24

File: USPT

Nov 2, 2004

US-PAT-NO: 6812705

DOCUMENT-IDENTIFIER: US 6812705 B1

TITLE: Coolant cooled RF body coil

DATE-ISSUED: November 2, 2004

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Sellers, Michael Ben	Florence	SC		

US-CL-CURRENT: 324/318; 324/315

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	FIG	Draw D
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☐ 12. Document ID: US 6774631 B2

L53: Entry 12 of 24

File: USPT

Aug 10, 2004

US-PAT-NO: 6774631

DOCUMENT-IDENTIFIER: US 6774631 B2

TITLE: Magnetic resonance gradient coil with a heat insulator disposed between the electrical conductor and the carrier structure

DATE-ISSUED: August 10, 2004

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Heid; Oliver	Gunzenhausen			DE

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	Publ	Drawings
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☐ 13. Document ID: US 6771072 B2

L53: Entry 13 of 24

File: USPT

Aug 3, 2004

US-PAT-NO: 6771072

DOCUMENT-IDENTIFIER: US 6771072 B2

TITLE: Magnetic resonance apparatus with an electrical conductor arrangement for electrical supply to a conduit

DATE-ISSUED: August 3, 2004

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Schuster; Johann	Oberasbach			DE
Stocker; Stefan	Erlangen			DE

US-CL-CURRENT: 324/318; 324/322

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	Publ	Drawings
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☐ 14. Document ID: US 6741152 B1

L53: Entry 14 of 24

File: USPT

May 25, 2004

US-PAT-NO: 6741152

DOCUMENT-IDENTIFIER: US 6741152 B1

TITLE: Directly cooled magnetic coil, particularly a gradient coil, and method for manufacturing conductors therefor

DATE-ISSUED: May 25, 2004

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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Arz; Winfried                      Erlangen                      DE  
Stocker; Stefan                    Erlangen                    DE

US-CL-CURRENT: 335/300; 174/15.1, 174/15.6, 174/47, 336/62

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	KMC	Draw D.
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☐ 15. Document ID: US 6516282 B2

L53: Entry 15 of 24

File: USPT

Feb 4, 2003

US-PAT-NO: 6516282

DOCUMENT-IDENTIFIER: US 6516282 B2

**\*\* See image for Certificate of Correction \*\***

TITLE: Predictive thermal control used with a vacuum enclosed coil assembly of a  
magnetic resonance imaging device

DATE-ISSUED: February 4, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Hedlund; Carl R.	Waterford	NY		
Emeric; Pierre R.	Milwaukee	WI		

US-CL-CURRENT: 702/132; 355/53

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	KMC	Draw D.
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☐ 16. Document ID: US 6441614 B1

L53: Entry 16 of 24

File: USPT

Aug 27, 2002

US-PAT-NO: 6441614

DOCUMENT-IDENTIFIER: US 6441614 B1

TITLE: Filler material for magnet resonant system self-shielded gradient coil  
assemblies

DATE-ISSUED: August 27, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Edelstein; William Alan	Schenectady	NY		
Hedeen; Robert Arvin	Clifton Park	NY		
Mantone; Anthony	Brookfield	WI		

US-CL-CURRENT: 324/318; 324/307, 324/309, 324/320, 324/322

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	KMC	Draw D.
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☐ 17. Document ID: US 6111412 A

L53: Entry 17 of 24

File: USPT

Aug 29, 2000

US-PAT-NO: 6111412

DOCUMENT-IDENTIFIER: US 6111412 A

TITLE: Gradient coil assembly and method of production of same

DATE-ISSUED: August 29, 2000

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Boemmel; Franz	Erlangen			DE
Schuster; Johann	Oberasbach			DE
Kaindl; Arthur	Erlangen			DE

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	IMP	Draw D
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☐ 18. Document ID: US 5886548 A

L53: Entry 18 of 24

File: USPT

Mar 23, 1999

US-PAT-NO: 5886548

DOCUMENT-IDENTIFIER: US 5886548 A

TITLE: Crescent gradient coils

DATE-ISSUED: March 23, 1999

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doty; F. David	Columbia	SC		
Wilcher; James K.	Columbia	SC		

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	IMP	Draw D
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☐ 19. Document ID: US 5661445 A

L53: Entry 19 of 24

File: USPT

Aug 26, 1997

US-PAT-NO: 5661445

DOCUMENT-IDENTIFIER: US 5661445 A

TITLE: Superconductive magnet assembly

DATE-ISSUED: August 26, 1997

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Larson, III; John D.	Palo Alto	CA		
Good; Jeremy A.	London			GB

US-CL-CURRENT: 335/216; 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	Notes	Draw D.
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☐ 20. Document ID: US 5554929 A

L53: Entry 20 of 24

File: USPT

Sep 10, 1996

US-PAT-NO: 5554929

DOCUMENT-IDENTIFIER: US 5554929 A

TITLE: Crescent gradient coils

DATE-ISSUED: September 10, 1996

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Doty; F. David	Columbia	SC		
Wilcher; James K.	Columbia	SC		

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	Notes	Draw D.
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☐ 21. Document ID: US 5539367 A

L53: Entry 21 of 24

File: USPT

Jul 23, 1996

US-PAT-NO: 5539367

DOCUMENT-IDENTIFIER: US 5539367 A

TITLE: Superconducting gradient shields in magnetic resonance imaging magnets

DATE-ISSUED: July 23, 1996

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Xu; Bu-Xin	Florence	SC		
Tsavalas; Yannis P.	Florence	SC		
Eckels; Phillip W.	Florence	SC		

US-CL-CURRENT: 335/301; 324/318, 335/216, 361/19

Full	Title	Citation	Front	Revised	Classification	Date	Reference			Claims	PMC	Drawings
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☐ 22. Document ID: US 5424643 A

L53: Entry 22 of 24

File: USPT

Jun 13, 1995

US-PAT-NO: 5424643

DOCUMENT-IDENTIFIER: US 5424643 A

TITLE: Magnetic resonance gradient sheet coils

DATE-ISSUED: June 13, 1995

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Morich; Michael A.	Mentor	OH		
Patrick; John L.	Chagrin Falls	OH		
DeMeester; Gordon D.	Wickliffe	OH		

US-CL-CURRENT: 324/318

Full	Title	Citation	Front	Revised	Classification	Date	Reference			Claims	PMC	Drawings
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☐ 23. Document ID: JP 11076199 A

L53: Entry 23 of 24

File: JPAB

Mar 23, 1999

PUB-NO: JP411076199A

DOCUMENT-IDENTIFIER: JP 11076199 A

TITLE: ANTENNA FOR MAGNETIC RESONANCE DEVICE

PUBN-DATE: March 23, 1999

## INVENTOR-INFORMATION:

NAME	COUNTRY
EBERLER, LUDWIG	
HEUBES, PETER	
MORITZ, MICHAEL	
STOECKEL, BERND	

INT-CL (IPC): A61 B 5/055; G01 R 33/32

Full	Title	Citation	Front	Revised	Classification	Date	Reference			Claims	PMC	Drawings
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☐ 24. Document ID: GB 2409279 A, US 6812705 B1

L53: Entry 24 of 24

File: DWPI

Jun 22, 2005

DERWENT-ACC-NO: 2004-793504

DERWENT-WEEK: 200541

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TITLE: Magnetic resonance imaging system used in medical procedure for obtaining detailed images of patient, comprises patient bore, gradient coil assembly, radio frequency coil assembly, copper stub, and non-conducting manifold

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	MAC	Draw D
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Clear	Generate Collection	Print	Fwd Refs	Bkwd Refs	Generate OACS
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Term	Documents
MAGNETIC	1523994
MAGNETICS	13432
RESONANCE	304281
RESONANCES	17789
MRI	28879
MRIS	409
NMR	150621
NMRS	257
(52 AND (MRI OR (MAGNETIC ADJ RESONANCE) OR NMR)).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	24
(L52 AND ((MAGNETIC ADJ RESONANCE) OR MRI OR NMR) ).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	24

Display Format:  [Previous Page](#)[Next Page](#)[Go to Doc#](#)

[First Hit](#) [Fwd Refs](#)[Previous Doc](#)[Next Doc](#)[Go to Doc#](#)

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Print

L53: Entry 14 of 24

File: USPT

May 25, 2004

DOCUMENT-IDENTIFIER: US 6741152 B1

TITLE: Directly cooled magnetic coil, particularly a gradient coil, and method for manufacturing conductors thereforAbstract Text (1):

A directly cooled magnetic coil, particularly a gradient coil for a magnetic resonance apparatus, has the conductors forming the windings which are provided with an inner cooling channel for conducting a cooling fluid therethrough, and the conductors are fashioned as profiled segment conductors whose individual profiled segments surround a cooling tube. The cooling tube is composed of material that is not electrically conductive, or is only slightly electrically conductive, particularly a flexible plastic.

Brief Summary Text (3):

The present invention is directed to a directly cooled magnetic coil, particularly a gradient coil for a magnetic resonance apparatus. The invention is also directed to a method for manufacturing conductors for a directly cooled magnetic coil.

Brief Summary Text (5):

In order to assure operation below a maximally allowed temperature of the gradient coil, it is necessary to designationally and efficiently eliminate the electrical dissipated power that arises in the form of heat. Since a dissipated power on the order of magnitude of more than 20 kW can be involved, considerable demands are made on the cooling system employed for this purpose.

Brief Summary Text (6):

German OS 34 45 448 discloses a gradient coil that is composed of two individual coils electrically connected in series. The individual coils are arranged in housing walls of a coil housing that lie opposite one another such that a free space remains for use as a cooling channel between the individual coils.

Brief Summary Text (7):

European Application 0 896 228 discloses an actively shielded gradient coil system with primary and shielding coils. Cooling tubes are located between these coils.

Brief Summary Text (8):

U.S. Pat. No. 5,068,491 discloses a rigid conductor for a power supply with coolant channels.

Brief Summary Text (10):

The provision of a cooling channel in the electrical conductor for the turns of the gradient coil requires a complete insulation of the coolant circulation path due to the high, and partially different voltages, in the region of the gradient coil and, given employment of water as the coolant, requires the use of highly distilled, non-conductive (i.e., non-ionized) water, which, of course, makes the operation extremely complicated and expensive. Given the high voltages and the direct contact between the water and the metallic conductors, an ionic contamination occurs after a relatively short time, and thus, the water becomes conductive, which absolutely must be avoided because of the risk of high-voltage arcing.

Brief Summary Text (12):

An object of the present invention is to provide a directly cooled magnetic coil of the type initially described wherein a simple operation is possible using non-processed water, as well as to provide a method for manufacturing conductors for such a directly cooled magnetic coil.

Brief Summary Text (13):

These objects are inventively achieved in a magnetic coil wherein the conductors are fashioned as profiled segment conductors whose individual profiled segments surround a cooling tube made of material that is electrically non-conductive, or only slightly conductive, particularly flexible plastic.

Brief Summary Text (14):

Due to the inventive structure of the coil, the cooling fluid is completely isolated from the inside wall of the electrical conductor to be cooled, so that if water is used as the coolant, it is not important whether the water has a more or less high electrical conductivity due to natural contaminants. A quasi-direct cooling of the conductors of the coil windings by the coolant takes place that is only slightly impeded by the small wall thickness of the electrically insulating cooling tubes, so that a very efficient cooling is established that opposes an excessive heating of the magnetic coil. Due to the small space requirement of an inventively constructed gradient coil compared to known versions with direct cooling and high, complicated outside insulation, or indirect cooling with cooling coils surrounding the gradient turns, the gradient coil windings can be positioned at more extreme radial distances, allowing an additional efficiency gain in the field generation. The elimination of water conditioning measures for lowering the specific electrical conductivity and for minimizing corrosion effects on the conductor material simplifies the operation of an inventively constructed, directly cooled magnetic coil and makes it less expensive.

Brief Summary Text (15):

The structure of the conductors for an inventive, directly cooled magnetic coil can include as the conductor segments, individual strands twisted with one another to form a stranded conductor that surrounds the cooling tube. The manufacture of such a conductor can preferably ensue by spinning the individual conductors around the cooling tube.

Brief Summary Text (16):

A design which has proven particularly advantageous in extensive tests on which the present invention is based has profiled segments in the form of rectangular (in cross-section) rods each having a channel with a semicircular cross-section, surrounding the cooling tube and positively locked thereto. Such a structure can be manufactured in an extremely simple way, since the rectangular conductors correspond to the profile shape that is standard for highly stressed gradient coils and can be easily laid via templets. Further individual conductors, i.e. solid conductors as well as stranded conductors, can be applied onto the outside surfaces of the profiled segments in order to enhance the effective conductor areas.

Brief Summary Text (17):

According to a further embodiment of the invention, at least some of the conductor segments applied at the cooling tube can be at in the form of retaining, embracing mounting webs which are mounted to, and at least partially surround, the cooling tube. For example, longitudinal webs which are offset relative to one another by 180.degree. can be applied to the cooling tube with a number of hooked cross-webs, spaced from each other, being attached to each longitudinal web. This embodiment yields a flexible plastic part, so that bending of the finished conductor is possible without problems. The actual conductor segments composed, for example, of copper can, of course, already be bent with good shape retention.

Brief Summary Text (18):

In a further embodiment of the invention, lateral tube profiles which respectively accept a profiled segment in a positively locked fashion are applied to the cooling tube, which in this embodiment preferably has a rectangular cross-section. These lateral tube profiles also preferably have a rectangular cross-section and form a smooth, rectangular outside contour. As warranted, parallel, spaced slots can thereby be provided in the walls of the lateral tube profiles that form the outside contour in order, similar to the exemplary embodiment described above having the spaced cross-webs, to enable a simple, shape-retaining bending of the finished conductors.

Brief Summary Text (19):

The manufacture of such coil conductor having profiled segments arranged in lateral tube profiles of the cooling tube can ensue very simply by coating or extrusion processes using thermoplastic plastics.

Drawing Description Text (2):

FIG. 1 is a simplified, perspective view of a cooling tube surrounded by two conductor segments in accordance with the invention.

Drawing Description Text (8):

FIG. 7 is a perspective view of an embodiment of an inventive conductor with a rectangular cooling tube and surrounding tube profiles for the interlocking acceptance of the profiled segments of the conductor.

Drawing Description Text (10):

FIG. 9 shows another embodiment of an inventive conductor, wherein a stranded conductor is spun around and the cooling tube.

Detailed Description Text (2):

In the exemplary embodiment according to FIGS. 1 and 2, the profiled segment conductor 1 is composed of two profiled segments 2 fashioned as rectangular rods each having a channel 4 with a semicircular cross-section surrounding, for example, a cooling tube 3 composed of plastic, in locking fashion. In the exemplary embodiment shown in FIGS. 1 and 2, wherein the two profiled segments can move relative to one another so that the conductor 1 can be bent with a tight radius of curvature, two further individual conductors 5 are provided in addition to the two profiled segments 2. These two further individual conductors 5 are applied onto the respective outside surfaces of the profiled segments 2 in order to enhance the effective conductor area. These additional individual conductors 5 alternatively can be fashioned with a structured surface or, for example, as stranded conductors.

Detailed Description Text (3):

FIGS. 3 and 4 show a double conductor composed of two conductors 1 arranged next to one another and provided with an interior cooling tube. In this way, a simpler and more efficiently cooled structure can ensue given especially thick, highly stressed individual conductors for gradient coils, in comparison to the larger structure of the individual conductor arrangement according to FIGS. 1 and 2. The connection of a number of such individual conductors to form a component part as in FIGS. 2 and 3, possibly with the double conductors according to FIGS. 2 and 3 disposed above one another as well, is simpler in terms of manufacturing technology and yields even more efficient cooling since the paths from the creation of the heat in the conductor to the coolant in the cooling channel 6 of the cooling tube are smaller.

Detailed Description Text (4):

Water is generally used as the coolant in the inventive conductive structure.

Detailed Description Text (5):

The directly cooled conductor according to FIGS. 5 and 6 has a cooling tube 3 with longitudinal webs 7 which are offset by 180.degree. relative to one another, to

which hooked cross-webs 9 proceeding vertically to the center plane 8 of the longitudinal webs are attached. These cross-webs 9 embrace, and thus hold together, the profiled segments 2 with their hooks 10. A separate connection of the parts to one another, as in the exemplary embodiment according to FIGS. 1 through 4, thus is not required in the arrangement according to FIGS. 5 and 6. Due to the spacing of the hooked cross-webs 9, a structure is achieved that can be easily or curved bent, so that the simple-shape-retaining bendability with tight bending radii of the metallic profiled segments 2 is still also assured for the entire, directly cooled conductor with the cooling tube and the applied webs.

Detailed Description Text (6):

A modified embodiment of an inventive, directly cooled conductor having an inside cooling channel 6 and a holder for the profiled segments 2' is shown in FIGS. 7 and 8. The generally rectangular cooling tube 3' is thereby surrounded by four, laterally adjoining tube profiles 11 that form a smooth rectangular outside contour in common with the cooling tube 3'. This outside contour is quadratic in the illustrated exemplary embodiment. This structure with the embedded profiled segments 2' can be produced in an extrusion process.

Detailed Description Text (7):

FIG. 9 shows an embodiment of an inventive conductor in cross-section wherein the cooling tube 3, is embedded in a stranded conductor 12, produced by spinning the individual strands 13 of the stranded conductor 12 around and on the cooling tube 3. This embodiment, however, is less beneficial than the versions disclosed above in view of the heat transfer from the outer strands to the coolant flowing in the cooling channel 6. The advantage of this exemplary embodiment is a low electrical resistance at high frequencies due to the division of the total coil current into many individual currents respectively flowing through the strands 13.

CLAIMS:

1. A directly cooled magnetic coil comprising: a conductor forming a coil winding for a gradient coil for a magnetic resonance apparatus, said conductor comprising at least two profiled electrical conductor segments which when fitted together, form an opening said conductor being adapted to carry a gradient current for operating said gradient coil, and a cooling tube disposed permanently in said opening and surrounded by said profiled segment conductors, said cooling tube being comprised of a substantially electrically non-conductive, flexible material, said cooling tube being adapted to carry ion-containing water therein as a coolant for said gradient coil, and said electrically non-conductive, flexible material preventing electrical arcing between said conductor and said ion-containing water.
3. A directly cooled magnetic coil as claimed in claim 1 wherein said profiled segment conductors comprise rectangular rods, each having a channel with a semicircular cross-section, surrounding said cooling tube and interlocked with each other.
5. A directly cooled magnetic coil comprising: a conductor forming a coil winding comprising at least two profiled electrical conductor segments which when fitted together, form an opening, a cooling tube disposed permanently in said opening and surrounded by said profiled segment conductors, said cooling tube being comprised of a substantially electrically non-conductive, flexible material, and said profiled segment conductors comprising rectangular rods, and each having a channel with a semi-circular cross-section, surrounding said cooling tube and interlocked with each other.

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☐ 1. Document ID: US 6741152 B1

L54: Entry 1 of 2

File: USPT

May 25, 2004

US-PAT-NO: 6741152

DOCUMENT-IDENTIFIER: US 6741152 B1

TITLE: Directly cooled magnetic coil, particularly a gradient coil, and method for manufacturing conductors therefor

DATE-ISSUED: May 25, 2004

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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Stocker; Stefan	Erlangen			DE

US-CL-CURRENT: 335/300; 174/15.1, 174/15.6, 174/47, 336/62

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	KMC	Draw D
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☐ 2. Document ID: US 6741152 B1, DE 19839987 A1, GB 2342986 A, DE 19839987 C2, GB 2342986 B

L54: Entry 2 of 2

File: DWPI

May 25, 2004

DERWENT-ACC-NO: 2000-207130

DERWENT-WEEK: 200435

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TITLE: Directly cooled magnetic coil especially gradient coil for magnetic resonance equipment - as moulded segments of inter-twisted individual flexible leads of stranded conductor placed around cooling tube

Full	Title	Citation	Front	Review	Classification	Date	Reference			Claims	KMC	Draw D
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